

# A Difference-in-Differences Analysis on the Impact of the Covid-19 Pandemic on Drinking and Binge Drinking in the United States

Yuxiang Liu <sup>a</sup>

*School of Energy Science and Engineering, Nanjing Tech University, Nanjing, China*

**Keywords:** Binge Alcohol Use, Alcohol Use, COVID-19, United States.

**Abstract:** The COVID-19 pandemic has brought profound and complex impacts on the global society and economy, and it has also revealed many problems in sanitation field. At the beginning of the pandemic, countries around the world experienced sudden lockdown policy that disrupted supply chains and led to a continuous downward trend of economic. Meanwhile, lifestyle has tremendous changes, with working at home, online teaching and isolation becoming part of daily life. The pandemic not only brings about challenges to economic development, but also has a long-term impact on people's mental health and social interaction. This study analysis estimated numbers of alcohol use and alcoholism in each state of United States before and after the pandemic, providing a scientific basis for countries to formulate policies to solve public health problems. Deploying a Difference-in-Differences analysis to analyse the impact of the pandemic on drinking and alcoholism in the United States before and after the epidemic. The result indicates that before and after the pandemic, the number of people who drinking and alcoholism has not changed in the United States.

## 1 INTRODUCTION

The pandemic had an impact on worldwide economic, society and sanitation. The pandemic not only has affected trade between countries, but also posed unprecedented challenges to society and public security. Among the social problems triggered by the epidemic, the changes in drinking and alcoholism deserve thorough exploration. Drinking may bring a sense of relief in short term, but this behaviour may gradually get out of control and develop into alcoholism once the dependence is formed. Alcohol abuse leads to a broad spectrum of liver diseases, collectively termed alcoholic liver diseases (Jisoo2025) and these lockdown policies tend to increase the occurrence of domestic violence because of isolation, coupled with economic and psychological stress (Sibiziwe2025). It has an influence on public health, closely affected social stability and economic development. Under the above background, this paper would analyse the reasons of drinking behaviour changes and the impacts on society.

The impact of the pandemic on traditional economic is manifested in the reduction of trade between countries and transnational investment due to

lockdown policies and travel restrictions. During the pandemic, many countries implemented lockdown policies, causing cross-border logistics and supply chains disruptions, which affected the trade of raw materials, components and products. The tourism sector was classified among the fast-growing and uncompetitive sectors before the pandemic. However, during the pandemic, it became a slow-growing and competitive sector (Liyushiana2022). Traditional service industries such as tourism and aviation have been severely affected. Enterprises are facing problems such as reduced transnational investment, program delays or cancellations, which further affect the global economy.

The pandemic has given rise to new economic opportunities, accelerated digital transformation and nurtured new economic forms. During the pandemic, in order to maintain the stability of enterprises' business, they adopted digital methods such as remote working and online retail, accelerating the transformation of information technology and business models. New business models like digital platforms, online education and telemedicine have risen rapidly, these models not only bring new development opportunities to enterprises, but also

<sup>a</sup> <https://orcid.org/0009-0003-7564-3393>

provide more convenient service to consumers. Companies should enhance supply chain relationship management and optimize the supply chain structure to reduce risk transmission and maintain sustainability (Shengmei2025).

The epidemic also had a negative impact on the economy. During the pandemic, due to differences in lockdown policies, economic foundations and policies among different countries and regions, there were significant variations in economic growth rates, which led to more uneven global economic growth. Many business organizations have implemented various remote-work arrangements. These arrangements have spurred the use of digitalization strategies and have landed many employees in the vulnerable virtual workplace (Low2021). The pandemic has generally affected low-income people and medium-sized enterprises. These groups have difficulty in obtaining support, which has led to reduced income and exacerbated unemployment, further widening the gap between the rich and the poor.

This paper analysis estimated numbers of alcohol use and alcoholism in various states of United States before and after the pandemic, providing a basis for governments to formulate policies to solve sanitation problems. Employing a Difference-in-Differences analysis to demonstrate the impact of the pandemic on drinking and alcoholism in the United States before and after the epidemic. Research results can provide intervention strategies for various countries' governments when facing similar public health emergencies in the future. For instance, if alcohol abuse shows a significant increase during the pandemic, it may be necessary to enhance mental health consulting, promote preventing alcohol abuse public education and adjust relevant regulations.

## **2 INFLUENCE FACTORS OF DRINKING UNDER THE PANDEMIC BACKGROUND**

### **2.1 The Psychological Pressure Brought About by the Pandemic**

The pandemic has given rise to new working and learning approaches such as working at home and online learning. For many people, this pattern has changed the original daily routine. On the one hand, the overlap of work and family roles compresses people's time schedule. On the other hand, unable to directly obtain social feedback also makes people have self-doubt and a sense of helplessness. Data

from several international studies indicate that healthcare workers are prone to developing mental health problems such as anxiety and depression (Temsah2020). When people receive negative news and pandemic transmission data every day, negative emotions and stress also increased. Long-term home quarantine, concern about the pandemic transmission, difficulty in distinguishing the authenticity of information and uncertainty of future have intensified public anxiety. Making people worry about themselves' and families' health condition and causing difficulties in making rational judgments, which lead to psychological problems such as anxiety, panic and depression. In a social environment where pressure is constantly increasing, some residents tend to relieve panic and anxiety by drinking alcohol, leading to drinking or even alcoholism behaviours.

### **2.2 The Economic Conditions Changes Caused by the Pandemic**

At the beginning of the epidemic, many countries adopted measures such as lockdown policy and cross-border trade restriction to prevent and control the epidemic, which led to temporary global supply chain disruptions. Many manufacturing enterprises have experienced a period of resuming work after suspension. It not only exposed a global supply chain problem that excessive dependent on few countries or regions, but also drove enterprises and governments to rethink how to build more flexible and resist risk supply chain. The pandemic has led to a large number of enterprises laying off staff and halting recruitment, which has severely impacted the labour market. The pandemic has led to the deterioration of the employment environment and instability of economic. Many people's economy and life condition are facing huge adjustments. Changes in the employment environment led to job stress in employees, which in turn increased employee job burnout and turnover intention (Shin2021). Income reducing with unstable jobs or unemployment, coupled with the continual life burden during the pandemic have added a lot of physical and mental pressure on people. Many people may drink alcohol as a temporary approach to escape reality, binge drinking has become a tool to deal with anxiety and depression.

### **2.3 The Social Interaction Changes Caused by the Pandemic**

The long-term lockdown policies and social restrictions have significantly reduced traditional

face-to-face social activities. Many people lost their normal social activities during home quarantine, making people lost the emotional support of face-to-face communication. The decrease in social interaction and increase in loneliness during the pandemic due to government directive, along with concerns of contracting the virus highlight the importance of digital services for adults to keep them connected and supported remotely (Wong2021). In the past, drinking alcohol as a social protocol was often restricted and supervised in friends' gatherings, family dinners, bars and restaurants. However, the restraint was broken during the pandemic and many drinking behaviours shifted to individuals make it difficult to restrict. Although online socializing and video gatherings have become new social interaction forms, they are difficult to completely replace the emotional interaction and atmosphere brought by traditional socializing. In face of loneliness and loss, people are more likely to rely on alcohol as an emotional companion, making alcohol a tool to relieve loneliness and loss when interpersonal communication decreases. Among those drinking more than once a week, increased alcohol consumption is associated with loneliness (Konno2022).

### 3 RESEARCH HYPOTHESES

When studying the impact of the pandemic on drinking and alcoholism behaviour in each state of the United States, this paper should analysis data before and after the epidemic as well as before and during the epidemic. These two comparisons can better reflect the impact of the epidemic on drinking and alcoholism behaviour, revealing the differences between short-term and long-term effects. In fact, comparing people's drinking behaviour during and before the epidemic can analyse the short-term impact. It helps us understand people's short-term alcohol consumption changes due to psychological pressure rise caused by lockdown policies and home quarantines.

Hypothesis 1. Before and after the pandemic, drinking and binge drinking in the United States has changed. After the pandemic, more people would be drinking and binge drinking than before the pandemic.

After the pandemic, people's drinking behaviour may return to normal and reveal long-term changes. By comparing the data before and after the epidemic, it is possible to realize whether short-term changes have an impact on long-term drinking behaviour and whether there is an upward trend after the epidemic,

thereby providing a scientific basis for formulating more effective intervention policies.

Hypothesis 2. Before and during the pandemic, drinking and binge drinking in the United States has changed. During the pandemic, more people would be drinking and binge drinking than before the pandemic.

In conclusion, analysing drinking and alcoholism data before and after the epidemic as well as before and during the epidemic can not only help researchers to understand the short-term and long-term impacts of the epidemic on sanitation more comprehensively, but also provides basis for government to deal with similar crises in the future.

## 4 METHODOLOGY

### 4.1 Data

The National Survey on Drug Use and Health (NSDUH) releases state estimates for a limited number of substance use and mental health measures. They are generally based on two years of combined data and cover each state and the District of Columbia. This study obtains the estimated figures (in thousands) of alcohol use and alcoholism. The figures are among people aged 12 to 20 in various states of the United States, which could be found on NSDUH State Releases platform.

### 4.2 Identification Strategy

This paper employs a natural experiment, which could clearly demonstrate the casual inferences (Christine2005). Apart from that, employ DID analysis to evaluate the P-value of the interaction term.

This study employs two DID analyses. First, the propose is to find out how drinking and alcoholism change in U.S. before and after the pandemic. Second, the propose is to find out how drinking and alcoholism change in U.S. before and during the pandemic. The control group is alcohol use estimate and the treatment group is binge alcohol use estimate.

### 4.3 Model Building

To evaluate the influence of pandemic on the drinking behavior, this paper measures the number of people who using alcohol in one outcome variables: Estimated Numbersit. The Estimated Numbersit is in group  $i$  at time  $t$ , where  $i$  represents the treatment or control group. The paper compares the estimated

numbers of the treatment groups and the control group when before and after(during) the pandemic:

$$\begin{aligned} \text{Estimated Numbers}_{it} = c + \\ \beta \text{Treated Period}_i + \gamma \text{Treated}_i \\ + \delta (\text{Treated Period}_i \times \text{Treated}_i) + e_{it} \end{aligned} \quad (1)$$

where  $e_{it}$  is the error term. The dummy variable  $\text{Treated}_i$  equals 1 means binge alcohol using and 0 otherwise. The dummy variable  $\text{Treated Period}_i$  equals 1 means before the pandemic and 0 means after(during) the pandemic. The coefficient  $\delta$  evaluates the estimated number difference across before and after(during) the pandemic.

## 5 DRINKING AND BINGE DRINKING CHANGE IN U.S.

### 5.1 Drinking and Binge Drinking Change in U.S. Before and after the Pandemic

Alcohol abuse is defined as consuming five or more glasses of alcohol (for men) and four or more glasses of alcohol (for women) on at least one day within last month. It is clear to see that 2018 and 2019 means before the pandemic and 2022 and 2023 means after the pandemic. This study downloads the raw data, after that, filter and categorize the data. Table 1 and Table 2 show the alcohol use and alcoholism estimated figures in last month among people aged 12 to 20 (in Thousands).

Table 1: Before the pandemic (2018 and 2019)

| Order | State                | Alcohol Use in Past Month Estimate | Binge Alcohol Use in Past Month Estimate |
|-------|----------------------|------------------------------------|------------------------------------------|
| 1     | Alabama              | 91                                 | 57                                       |
| 2     | Alaska               | 14                                 | 9                                        |
| 3     | Arizona              | 141                                | 82                                       |
| 4     | Arkansas             | 61                                 | 37                                       |
| 5     | California           | 800                                | 471                                      |
| 6     | Colorado             | 143                                | 86                                       |
| 7     | Connecticut          | 121                                | 82                                       |
| 8     | Delaware             | 21                                 | 11                                       |
| 9     | District of Columbia | 11                                 | 6                                        |
| 10    | Florida              | 428                                | 235                                      |

Table 2: After the pandemic (2022 and 2023)

| Order | State                | Alcohol Use in Past Month (Estimate) | Binge Alcohol Use in Past Month (Estimate) |
|-------|----------------------|--------------------------------------|--------------------------------------------|
| 1     | Alabama              | 94                                   | 62                                         |
| 2     | Alaska               | 11                                   | 6                                          |
| 3     | Arizona              | 125                                  | 75                                         |
| 4     | Arkansas             | 49                                   | 29                                         |
| 5     | California           | 618                                  | 345                                        |
| 6     | Colorado             | 117                                  | 64                                         |
| 7     | Connecticut          | 74                                   | 44                                         |
| 8     | Delaware             | 16                                   | 9                                          |
| 9     | District of Columbia | 9                                    | 5                                          |
| 10    | Florida              | 335                                  | 167                                        |

Table 3 shows drinking and binge drinking change in United States before and after the pandemic. Figure 1 shows the DID analysis time series. The

objective is to compare whether alcoholism is significantly more than drinking before and after the pandemic or not.

Table 3: DID calculation before and after the pandemic

|                           | Before | After |
|---------------------------|--------|-------|
| Control Group             | 139.1  | 111.9 |
| Treatment Group           | 83.8   | 63.1  |
| Difference                | -55.3  | -48.8 |
| Difference in Differences | 7      |       |

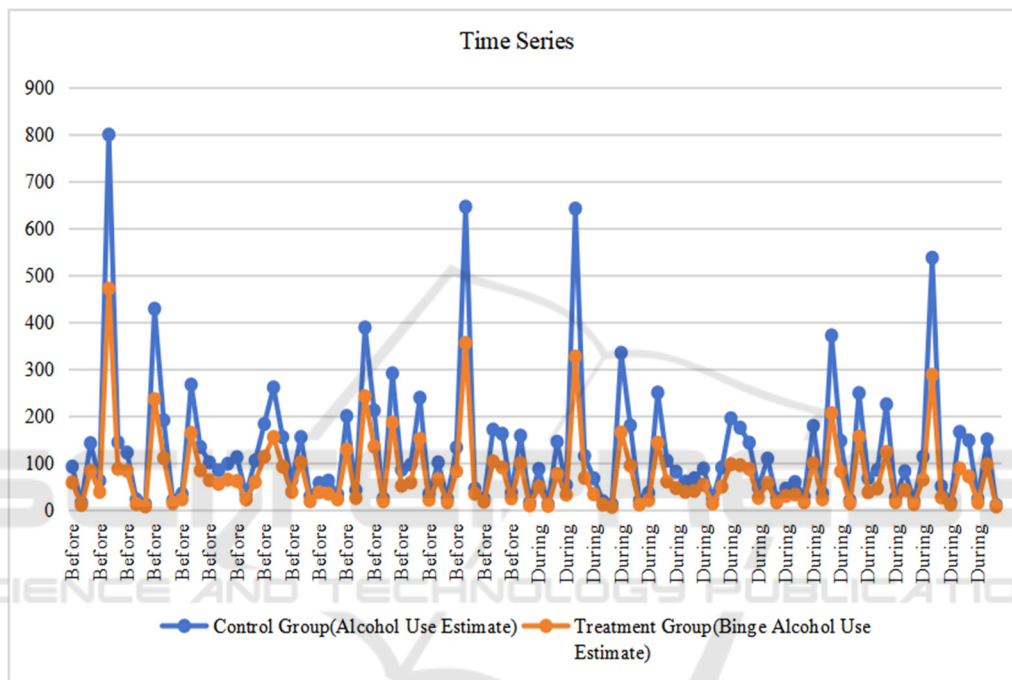


Figure 1. Time series before and after the pandemic (Picture credit : Original)

Table 3 and Table 4 show the DID analysis. There are the results of the DID analysis and the regression results. The result of DID analysis before and after the pandemic is 7, which means that the estimated

number increase by 7 after the pandemic. It is clear to see that the P-value is 0.83, which is much higher than 0.05, means the impact is not statistically significant.

Table 4: Regression results before and after the pandemic

|                                  | Coefficients | Standard Error | t Stat | P-value |
|----------------------------------|--------------|----------------|--------|---------|
| Intercept                        | 139.12       | 15.72          | 8.85   | 0.00    |
| After                            | -27.24       | 22.24          | -1.22  | 0.22    |
| Treated                          | -55.33       | 22.24          | -2.49  | 0.01    |
| Interaction Term (After*Treated) | 6.57         | 31.45          | 0.21   | 0.83    |

## 5.2 Drinking and Binge Drinking Change in U.S. Before and During the Pandemic

pandemic. Table 1 and Table 5 show the alcohol use and alcoholism estimated figures in last month among people aged 12 to 20 (in Thousands).

It is clear to see that 2018 and 2019 means before the pandemic and 2021 and 2022 means during the

Table 5: During the pandemic (2021 and 2022)

| Order | State                | Alcohol Use in Past Month (Estimate) | Binge Alcohol Use in Past Month (Estimate) |
|-------|----------------------|--------------------------------------|--------------------------------------------|
| 1     | Alabama              | 86                                   | 48                                         |
| 2     | Alaska               | 11                                   | 7                                          |
| 3     | Arizona              | 144                                  | 75                                         |
| 4     | Arkansas             | 52                                   | 31                                         |
| 5     | California           | 642                                  | 326                                        |
| 6     | Colorado             | 114                                  | 67                                         |
| 7     | Connecticut          | 66                                   | 32                                         |
| 8     | Delaware             | 17                                   | 10                                         |
| 9     | District of Columbia | 10                                   | 5                                          |
| 10    | Florida              | 334                                  | 164                                        |

Table 6 shows drinking and binge drinking change in United States before and during the pandemic. Figure 2 shows the DID analysis time

series. The objective is to compare whether alcoholism is significantly more than drinking before and during the pandemic or not.

Table 6: DID calculation before and during the pandemic

|                           | Before | After |
|---------------------------|--------|-------|
| Control Group             | 139.1  | 117.3 |
| Treatment Group           | 83.8   | 64.0  |
| Difference                | -55.3  | -53.3 |
| Difference in Differences | 2      |       |

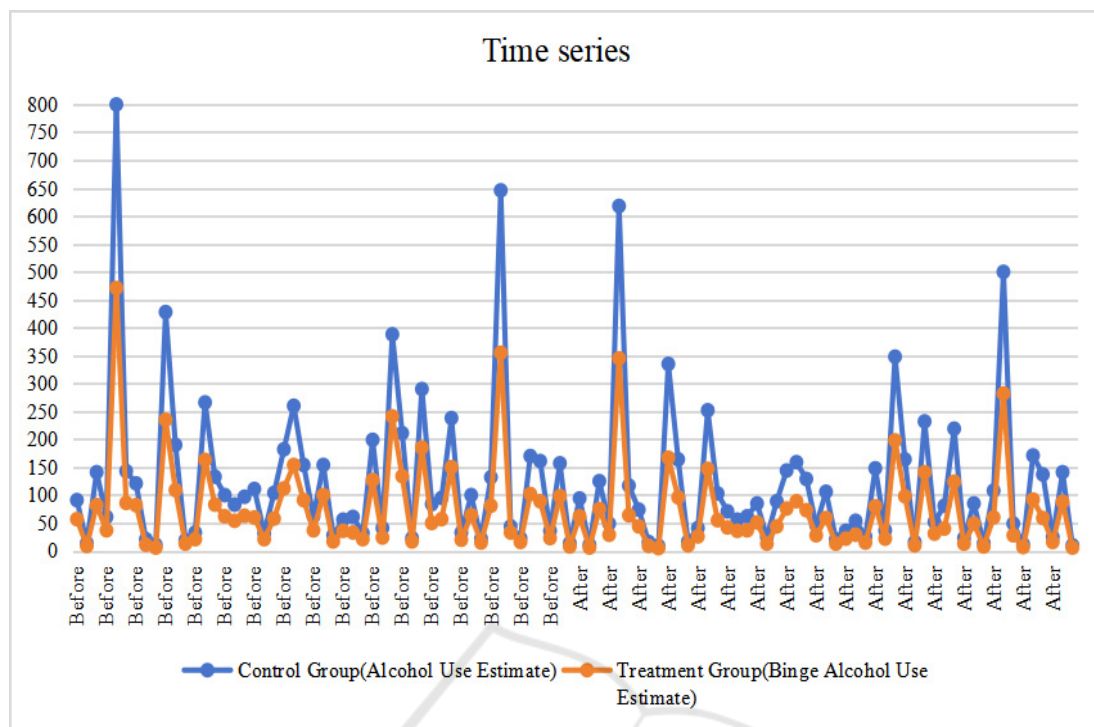


Figure 2. Time series before and during the pandemic (Picture credit: Original)

Table 6 and Table 7 show the DID analysis. There are the results of the DID analysis and the regression results. The result of DID analysis before and during the pandemic is 2, which means that the estimated number increase by 2 during the pandemic. It is clear to see that the P-value is 0.95, which is much higher than 0.05, means the impact is not statistically significant.

Table 7: Regression results before and during the pandemic

|                                  | Coefficients | Standard Error | t Stat | P-value |
|----------------------------------|--------------|----------------|--------|---------|
| Intercept                        | 139.12       | 15.95          | 8.72   | 0.00    |
| After                            | -21.84       | 22.55          | -0.97  | 0.33    |
| Treated                          | -55.33       | 22.55          | -2.45  | 0.01    |
| Interaction Term (After*Treated) | 2.08         | 31.89          | 0.07   | 0.95    |

## 6 DISCUSSION

The results indicate that the alcoholics were not specifically affected. The interaction term did not significantly indicate that the additional impact on binge alcohol user is different from which to alcohol user before and after the pandemic.

Although people's stress and anxiety increased during the epidemic, the number of people who drinking and binge drinking did not increase significantly. Binge drinking users' behaviour is often closely related to social occasions, such as bars, family dinners or gatherings with friends. During the epidemic, due to the prevention policies restrictions, social activities and home quarantine, traditional drinking places and social activities have decreased significantly. The lack of drinking occasions may cause some binge alcohol users to increase their drinking frequency at home. However, the absence of large-scale social activities keeps the number of drinkers remain stable.

The pandemic has changed people's daily life and consumption custom. People began to live at home during the pandemic and their attention to health were also increased. Meanwhile, economic pressure and concerns about future have also prompted some

people to reduce non-essential consumption. It has led to a downward trend in the amount and frequency of alcohol consumption due to the lack of drinking occasions.

Drinking behaviour is a kind of habit. Long-term heavy drinkers often have formed a fixed drinking frequency and will not increase their drinking frequency due to external environment changes, for those who do not drink or drink moderately, the pandemic has not prompted them to develop new alcohol abuse behaviours. Although some people may increase drinking frequency due to psychological stress, the overall number of people who drinking and alcoholism has not increased. These two parts balance each other, thus keeping the overall number of people remain stable.

## 7 CONCLUSION

Through research, this paper finds that the impact of the COVID-19 pandemic on drinking and binge drinking before and after(during) the pandemic is not statistically significant. Therefore, the result indicates that the number of people who drinking and alcoholism remain stable, their attention to health is increased, heavy drinkers have formed a fixed drinking frequency and would not increase that during the pandemic, for those who never drink or drink moderately, the pandemic has not prompted them to develop new alcohol abuse behaviours.

Overall, the COVID-19 pandemic has not only posed challenges to global society and economy, but also made us more clearly about the importance of drinking problem in public health field. In the future, each country needs to take a long-term perspective to improve sanitation policies, and comprehensively address the health, social and economic issues exposed by the epidemic, which in order to promote the overall social health level and economic steady improvement.

This paper has a few limitations. First, this study analysis estimated numbers of alcohol use and binge alcohol use in each state of United States. However, this paper is unable to take the inherent difference of each state into account, such as population, geographical location and lockdown policy. Future research could take the inherent difference into account to carry out further study. Second, this paper analysis estimated numbers in each state of United States. However, this paper is unable to analysis the substate data, such as estimated numbers in different county of each state. Future research can take the

county data into account to carry out further study on this issue.

## REFERENCES

- Anderson-Cook, C. M., 2005. Experimental and quasi-experimental designs for generalized causal inference. *Journal of the American Statistical Association*, 100(470), 708-708.
- Chen, S., & Ren, G., 2025. The impact of exogenous shocks on the sustainability of supply chain relationships: Evidence from the COVID-19 pandemic. *Sustainability*, 17(7), 2828-2828.
- Kang, J., Park, S. H., Khanam, M., Park, S. B., Shin, S., & Seo, W., 2025. Impact of binge drinking on alcoholic liver disease. *Archives of Pharmacal Research*, 48(3), 1-12.
- Konno, Y., Okawara, M., Hino, A., Nagata, T., Muramatsu, K., Tateishi, S., ... & Fujino, Y., 2022. Association of alcohol consumption and frequency with loneliness: A cross-sectional study among Japanese workers during the COVID-19 pandemic. *Heliyon*, 8(12), e11933-e11933.
- Liyushiana, Sibarani, R., Purwoko, A., & Emrizal, 2022. The contribution of the tourism sector to the regional spatial economy during the COVID-19 pandemic. *International Journal of Sustainable Development and Planning*, 17(8).
- Low, M. P., & Bu, M., 2021. Examining the impetus for internal CSR practices with digitalization strategy in the service industry during COVID-19 pandemic. *Business Ethics, the Environment & Responsibility*, 31(1), 209-223.
- Shin, D., Kim, Y., & Kim, B., 2021. Understanding job stress and organizational effectiveness of airline employees due to changes in the employment environment under COVID-19 – Focusing on the difference in the GAD-7 of employees. *Sustainability*, 13(24), 13722-13722.
- Shumba, S., Muyangata, J., & Nyangari, E., 2025. The COVID-19 pandemic and domestic violence: A case of African Christian women in Gwanda district, Zimbabwe. *Inkanyiso*, 17(1), e1-e10.
- Temsah, M. H., & Alenezi, S., 2020. Understanding the psychological stress and optimizing the psychological support for the acute-care health-care workers during the COVID-19 pandemic. *Saudi Critical Care Journal*, 4(5), 25-27.
- Wong, Z. X., Phua, A., Chew, K. A., Mohamed, J. S., Pérez, K. M., Mangialasche, F., ... & Chen, C., 2021. Impact of Covid-19 pandemic on lifestyle in a middle-aged and elderly population. *Alzheimer's & Dementia*, 17(S10).